Recurrence Relations Past Paper Pack

Edexcel Further Pure 2 June 2019

The number of visits to a website, in any particular month, is modelled as the number of visits received in the previous month plus k times the number of visits received in the month before that, where k is a positive constant.

Given that V_n is the number of visits to the website in month n,

(a) write down a general recurrence relation for V_{n+2} in terms of V_{n+1}, V_n and k.

(1)

For a particular website you are given that

- $k = 0.24$
- In month 1, there were 65 visits to the website.
- In month 2, there were 71 visits to the website.

(b) Show that

$$V_n = 50(1.2)^n - 25(-0.2)^n$$

(5)

This model predicts that the number of visits to this website will exceed one million for the first time in month N.

(c) Find the value of N.

(2)

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Solve the recurrence system

$$u_1 = 1 \qquad u_2 = 4$$
$$9u_{n+2} - 12u_{n+1} + 4u_n = 3n$$

(9)

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A staircase has n steps. A tourist moves from the bottom (step zero) to the top (step n). At each move up the staircase she can go up either one step or two steps, and her overall climb up the staircase is a combination of such moves.

If u_n is the number of ways that the tourist can climb up a staircase with n steps,

(a) explain why u_n satisfies the recurrence relation

$$u_n = u_{n-1} + u_{n-2}, \text{ with } u_1 = 1 \text{ and } u_2 = 2$$

(3)

(b) Find the number of ways in which she can climb up a staircase when there are eight steps.

(1)

A staircase at a certain tourist attraction has 400 steps.

(c) Show that the number of ways in which she could climb up to the top of this staircase is given by

$$\frac{1}{\sqrt{5}}\left[\left(\frac{1+\sqrt{5}}{2}\right)^{401} - \left(\frac{1-\sqrt{5}}{2}\right)^{401}\right]$$

(5)